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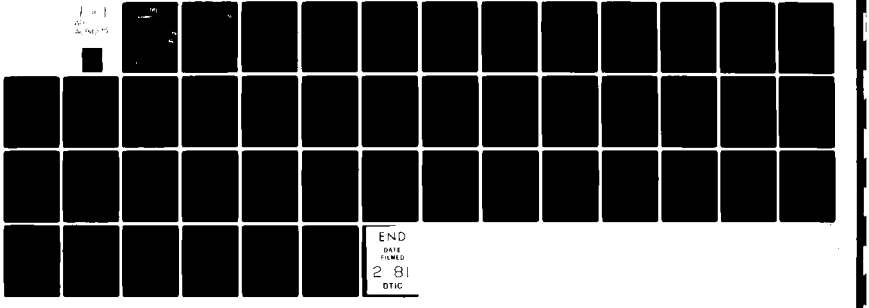

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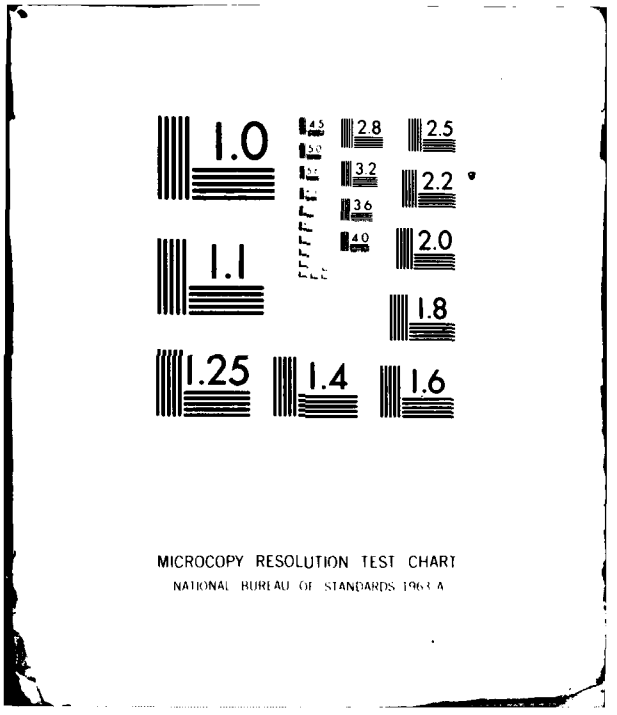
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Interim Report

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by

Edgar M. Haverland

HUMAN RESOURCES RESEARCH ORGANIZATION

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March 1974

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This Interim Report describes a preliminary model for evaluating specific training approaches and/or innovations in relation to specific training settings. The evaluation is accomplished by systematically comparing the characteristics of the approach/innovation with the corresponding characteristics or requirements of the setting. The function of the model is to aid in eliciting and arranging information so that all relevant information is obtained and arrayed in a way that facilitates decision-making.

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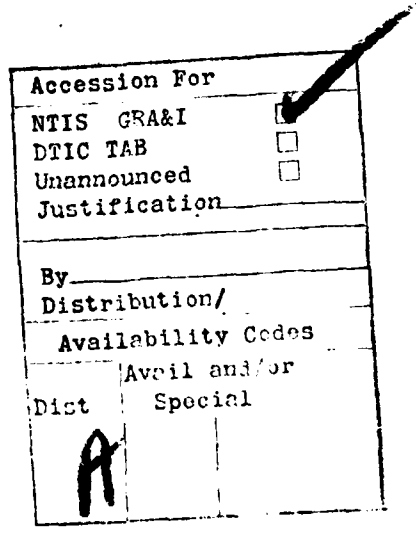
FOREWORD

This interim report describes work undertaken by the Human Resources Research Organization, under Research Project AFTEC, Basic Research Relevant to U.S. Air Force Technical Training, for the Air Force Office of Scientific Research. The development of a preliminary version of a model for evaluating training approaches in relation to specific training settings is discussed.

The research is being conducted at HumRRO Division No. 7 (Social Science), Alexandria, Virginia. Dr. Robert G. Smith, Jr., is the Director of the Division, and Dr. Edgar M. Haverland is the principal investigator for the project.

The project is being conducted for the U.S. Air Force Office of Scientific Research under Contract F44620-74-C-007.

Meredith P. Crawford
President
Human Resources Research Organization



CONTENTS

A MODEL FOR MATCHING TRAINING APPROACHES WITH TRAINING SETTINGS

Chapter 1

INTRODUCTION AND OBJECTIVE

INTRODUCTION

Training in the U.S. Air Force is characterized by massive coverage of a wide range of content, and by the necessity for frequent revision or replacement of substantial proportions of the vast array of training materials, in order to keep pace with changing requirements and programs. In one recent year, it was estimated that of the 300,000 hours of different kinds of training being presented in the Air Training Command, between 50,000 and 75,000 hours were being phased out, to be replaced by new training material covering different content and between 50,000 and 60,000 hours were being revised.[1]

Much of this training is quite expensive, and some of it involves large numbers of students. In technical training alone, the Air Force spends over half a billion dollars and graduates more than 150,000 persons a year from five technical schools and numerous on-the-job training courses (Carpenter, 1972). Thus, improvements in the effectiveness of training have the potential for saving large amounts of money.

In a training system in which more than one-third of the training is being revised or developed during any given year, and in which so much money is spent and so many persons trained, the effectiveness of the training development process is crucial in determining the efficiency of the system. As training is developed or revised, there is always the opportunity to choose more effective training approaches. In developing training for any particular setting, there will always be a wide range of approaches from which to choose, some genuinely new and innovative, and some, while already in use in other settings, new to the particular setting. Effective use of training technology depends heavily on careful evaluation and wise choice of training approaches in the training development process.

OBJECTIVE

The objective of this project is to contribute to the effective use of training technology through the development of a model for evaluating training approaches or innovations in relation to specific training settings. The applicability or potential usefulness of the training approach or innovation in a particular training setting is evaluated by systematically comparing the characteristics of the training approach or innovation with the corresponding characteristics or requirements of the training setting.

DEFINITIONS

The term "training approach" is intended to include any method, technique, device, or system considered for use in training. Examples range from simple audiovisual devices

[1] Personal communication with Chester L. Bueker, 31 October 1973.

intended to support an ongoing program of training, to comprehensive training systems, the adoption of which would revamp large elements of the training organization. Earlier work in this project used the term "training innovation," but "training approach" has been adopted as a neutral term to signify any method, technique, device, or system being considered for adoption in a training setting, whether it is truly an innovation, or has already been used in a variety of other training settings.

"Training setting" is also intended to be a neutral term with wide applicability. For example, a particular training setting could be defined in relation to an entire course, lasting many weeks, to a major portion of such a course, or to a small segment of it, dealing with a particular topic or skill and lasting for a few days or even hours.

The term "training setting" is intended to include (a) the nature of the training content, as embodied in the training objectives for the course or portion of the course; (b) the physical and personnel resources of the training establishment—including the buildings or classroom or other space available for the course or portion thereof, training or operational equipment, and instructional and supervisory personnel; (c) the policies and requirements of the personnel and training administrative systems involved—as well as general policies and constraints of the training center or agency responsible; (d) the abilities, previous experience, physical characteristics, and attitudes of the trainees.

This model would normally be used when the training setting is given, and the problem is to select training approaches, either for insertion into an ongoing program of training, or in developing a new course or training program. It would also be possible to make an inventory of the characteristics of a training setting, without any particular training approach in mind, and from the information accumulated infer something about the kinds of training approaches that would be usable in this training setting. This approach might be especially useful in developing, from the beginning, a new course or training program.

RELATIONSHIP OF PROJECT TO RESEARCH LITERATURE

Research literature on social and organizational change is extensive and varied (Bennis, Benne, and Chin, 1969; Havelock, *et al.*, 1969; Shashkin, Morris, and Horst, 1973). The many studies in this literature deal with numerous areas of change (in medicine, education, agriculture, transportation, and general technology, for example), and with various aspects of the change process, such as the role of change agents, the influence of mass media, the communication process generally, resistance to change, and conceptualizations of the change process.

This project deals with an aspect of the vast subject of social and organizational change that has not received much attention in any of this literature—the explicit consideration of the user's needs and requirements as a basis for choosing the particular change or innovation to be implemented. The problem-solver model for social change (Havelock, *et al.*, 1969, pp. 2-40) does give user needs a central place in the change process, and the work of Niehoff (1969) on the factors determining the success or failure of efforts to introduce planned changes in primitive or underdeveloped societies strongly emphasizes the importance of users' needs, as perceived by the users themselves, in determining success or failure of attempted innovations. Otherwise, this literature is much more concerned with the processes and techniques of getting changes accepted and implemented, than with the choice of what changes to attempt.

This project may be viewed as a contribution to a relatively neglected aspect of the study of social and organizational change, although its primary importance lies in its potential contribution to more effective Air Force training.

SCOPE OF THE REPORT

This interim report will describe the preliminary version of the model, including the approaches taken in its derivation to date, and its application, on a trial basis, to a number of training approaches. The relationship of the model to Instructional System Development (ISD) procedures (U.S. Air Force, 1970), the Rand Corporation's MODIA system for designing programs of instruction (A Method of Designing Instructional Alternatives) (Carpenter, 1972; Carpenter and Horner, 1972; Bretz, 1972; and Petruschell and Carpenter, 1972), and to the Advanced Instructional System (AIS) (Rockway and Yasutake, 1973), will be discussed.

The plans for testing and revising the model during the remaining part of this project will also be described. These plans include applying the model to some training settings and to additional training approaches as well as gathering information from training managers and planners in the USAF Air Training Command concerning the suitability and usefulness of the model in evaluating proposed training approaches for USAF technical training.

Chapter 2

DESCRIPTION OF THE MODEL

PURPOSE OF THE MODEL

The specific purpose of the model is to facilitate, and provide a format for the systematic gathering and arranging of information on the characteristics of training approaches and training settings so that the "fit," or potential usefulness of a particular approach in a particular setting can be evaluated.

The procedure has been essentially to ask a series of questions about the training approach under consideration, and a parallel series about the training setting. Thus the function of the model is to aid in eliciting and arranging information so that all relevant information is obtained and arrayed in a way that facilitates decision-making. The final decision concerning the extent to which the training approach fits this particular training setting remains a matter for judgment, but good, sound judgment should be made much easier and more likely if the relevant information is available and clearly displayed.

INITIAL DEVELOPMENT OF THE MODEL

The derivation of this model was begun by considering a number of training approaches and asking the question, "What features do these training approaches have that would make a difference in their suitability for use in a particular training setting?" From the first tentative answers to this question, the following preliminary outline of characteristics emerged:

(1) Student Characteristics
   a. Is the training approach sensitive to aptitude variations?
   b. What is the minimum number of students required for the approach to be feasible? How does the approach handle much larger numbers of students?
   c. What is the size of student groups required or desirable for the approach, and how are they organized?
   d. Are any special aptitudes or capabilities required of the students (e.g., reading ability at a specified level)?

(2) Instructor Characteristics
   a. What is the minimum number of instructors required? Instructor-student ratio?
   b. What special skills or training do the instructors need?
   c. What roles do instructors play in implementing the training approach (i.e., what is the nature of the activities required of instructors—presenting information, managing student learning activities, evaluating student performance)?

(3) Training Content Characteristics
   a. For what types of content is this training approach particularly appropriate?

b. What implications does the training approach have for the organization and sequencing of training content?
c. How much effort is necessary to develop and to revise training materials for this training approach?

(4) Physical Setting Characteristics
a. How much and what kind of space (classroom, laboratory, field maneuver) does this training approach require?
b. Is operational (or obsolete) equipment required with this training approach?
c. Are training devices required, and what level of fidelity is needed?
d. What are the requirements for printed training material?
e. Is this training approach suitable for use at dispersed or remote sites?

It may be noted that this preliminary outline of characteristics is categorized in terms of major elements of the training setting—students, instructors, training content, and physical setting. This classification was not preconceived; it simply emerged as a natural classification for the kinds of characteristics that were obtained as answers to the question "What features do these training approaches have that would make a difference in their suitability for use in a particular training setting?"

TESTS OF THE PRELIMINARY OUTLINE OF CHARACTERISTICS

The preliminary outline of characteristics was then used in examining a number of training approaches to obtain an indication of the feasibility of this manner of developing the model. Some of the training approaches selected for examination were abstracted from HumRRO training research, and were intended to represent the kind of fundamental, systematic approaches to training that appeared to offer substantial possibilities of improvement in the effectiveness of training. Also, because of their relatively fundamental and comprehensive nature, they are likely to be more difficult to evaluate than simpler training approaches involving, for example, a new audiovisual device. Thus, the first tests of this developing model were of substantial difficulty and scope.

Also included in the training approaches selected for examination was the Lincoln Training System, which depends completely on a sophisticated piece of instructional equipment. This training approach was selected in order to extend the tests of the developing model in the direction of instructional equipment, since Air Force instructional programs are making increasing use of this kind of equipment.

The training approaches examined, with the preliminary outline of characteristics and the nature and results of that examination, are described in the following sections.

Peer Instruction (Progressive)

This training approach and the following one (Mastery Testing) were abstracted from the research conducted under HumRRO Work Unit APSTRAT (Weingarten, Hungerland, and Brennan, 1972).

> The Peer Instruction Training Approach is defined as a system of instruction in which a student instructor teaches a student learner a segment or module of the content to be learned, while a student observer looks on at a specified learning station for this module. When the student learner has satisfactorily learned the module he becomes the student instructor, the student observer becomes the student learner, and another person joins the group as a student observer. Meanwhile, the original student instructor moves on to become the student observer at another learning station dealing with another module. The term "progressive" is used to denote this rotation of students through several roles in the system.

(1) Student Characteristics
   a. Insensitive to aptitude variations
   b. Minimum number of persons must be in training, depending on number and length of modules, for efficient use of instructional materials and equipment; large numbers of students handled by multiple learning stations for each module
   c. Rotating groups of three students at each learning station—instructor, learner, and observer
   d. No special aptitudes required, except as demanded by training content; one-to-one instructor-learner ratio provides maximum flexibility to adapt to requirements of individual student-learners
(2) Instructor Characteristics
   a. Number required—relatively few; instructor-student ratio—not critical
   b. Special skills or training—none, other than reasonably proficient in training content involved
   c. Role of instructors—managers and schedulers of instruction
(3) Training Content Characteristics
   a. Appropriate for a wide variety of types of content
   b. Implications for organization and sequencing of training content—must be modularized, in order to set up learning centers; modularization should facilitate sequencing so that prerequisite learning is accomplished
   c. Training development and revision effort—requires careful analysis of training content so as to modularize the content and set up learning stations; training revision effort should be relatively small since modularization facilitates revision
(4) Physical Setting Characteristics
   a. Requires a lot of space, since one or more learning stations must be set up for each module of content; type of space depends on training concept
   b. Operational equipment may or may not be required, depending on other aspects of learning situation, such as whether simulation is used
   c. Requirements for training devices—depends on training content, and whether use of operational equipment is feasible
   d. Requirement for printed material—minimal (administrative and record-keeping only) if job-related equipment is used; if learner activities involve printed material, there is a larger requirement
   e. Dispersed or remote sites—probably not, unless operational equipment on such sites is used with traveling administrator-trainer teams

Mastery Testing (With Modularized Training)

The Mastery Testing Training Approach is defined as a procedure in which students are required to demonstrate acceptable performance on a module of training content before being allowed to continue with the next module. Students who cannot demonstrate acceptable performance in a mastery test must study or practice further and pass the mastery test before continuing with another module.

(1) Student Characteristics
   a. Insensitive to aptitude variations
   b. Numbers of students required or permitted not crucial; large numbers of students can be accommodated by having multiple testing stations for each module
   c. No necessary implication for size or organization of student groups
   d. Special aptitudes required; depends on performance being tested
(2) Instructor Characteristics
   a. Number required—depends on number of modules of training content and number of students; not particularly heavy requirements for instructors

b. Special skills or training—test administration, quality control orientation
c. Role of instructors—test administrators, with responsibility for quality control (i.e., insuring that students have mastered training content

(3) Training Content Characteristics
a. Type of content appropriate; suitable for a wide variety
b. Implications for organization and sequencing of training content—requires modularization of training content, approach is particularly appropriate if some parts of training content are clearly prerequisite to others

(4) Physical Setting Characteristics
a. Amount and kind of space needed—depends on nature of job performance being trained
b. Requirement for operational equipment—desirable when possible, but simulated performance can be used
c. Requirements for training devices—desirable if possible for more realistic testing in some cases (fidelity requirements depend on training content)
d. Requirements for printed material—minimal, unless testing procedures require a great deal of printed material
e. Dispersed or remote sites—normally not, but could be done with traveling testing teams

Lincoln Training System (LTS-4)

This training approach was taken from the description of the equipment provided by Frick (1973), and its use in demonstrating an economical method for preparing proceduralized instructional material (Frick and Karp, 1973).

> The Lincoln Training System Training Approach is defined as a computer-controlled, stand-alone microfiche system that combines visual images, voice-quality sound recordings, and computer control logic on the same fiche. Under computer control, the system can select any of up to 750 microfiche, each with 12 images and 12 associated audio frames, with up to 28 seconds of speech on each frame. The system presents individualized, interactive instruction utilizing both visual and auditory modes of presentation.

(1) Student Characteristics
a. Aptitude level of students—not applicable; depends on nature of instructional material designed for use in equipment
b. Number of students—one per terminal while in use
c. Organization of students—none—individualized instruction
d. Special aptitudes—audio facility helps solve the problem of poor readers

(2) Instructor Characteristics
a. Number required—minimal
b. Special skills or training—minimal, assuming instructional material is good
c. Role of instructors—minor involvement (issuing sets of fiche, record keeping, etc.)

(3) Training Content Characteristics
a. Type of content appropriate—wide range possible
b. Implications for organization and sequencing of training content—small step inherent in system, flexible sequencing possible, system has random access capability
c. Training development and revision effort—development effort varies widely depending on approach taken in analyzing training content, equipment does *not* impose burdens here. Training revision effort is less than for comparable printed materials, since large production volumes are not needed for economy in making microfiche, as with printed materials

(4) Physical Setting Characteristics
   a. Space requirements—indoors; amount needed for one terminal per student during the time on the system
   b. Requirements for operational equipment—depends on how it is used (can be used as a job aid in operating or maintaining operational equipment, or as a stand-alone training system)
   c. Requirements for training devices—probably none
   d. Requirements for printed materials—little or none
   e. Can be used at dispersed and remote sites for individual instruction

Operational Context Training

This training approach was taken from the report of a HumRRO research project (Work Unit LOCK-ON) carried out some years ago (Woolman, 1960). It was chosen in order to extend the tests of the developing model into the area of on-the-job training, and because the approach, as applied in the original HumRRO study, produced a rich amalgam of training techniques well adapted to the constraints and requirements of the field training situation for which it was designed.

> The Operational Context Training Approach is defined as a flexible, decentralized method of OJT, utilizing as its primary training unit a group consisting of one instructor skilled and experienced in the job to be trained (but not in instruction techniques) and two students. The method also involves:
>
> - A Training Guide that describes the method generally and provides specific guidance on the procedures or skills to be learned by students.
> - An elementary method of instruction for the guidance of novice instructors.
> - Training content organized in modules or blocks, with
> - Proficiency-based advancement in training, based on
> - A simple six-point rating scale used by the training unit instructors during training and by training supervisors for qualifying students to advance to a later module of training.
> - A system of records and charts to record and display student progress for both information and motivational purposes.
> - An interviewing and counselling system to deal with students whose performance is unsatisfactory.
>
> The method is designed to be used in a field or operational setting, and depends heavily on relatively low-level personnel who are given explicit guidance in following the system.

(1) Student Characteristics
   a. Insensitive to aptitude variations
   b. Flexible as to numbers of students
   c. Two students to each instructor
   d. No special aptitudes required

(2) Instructor Characteristics
   a. One instructor for every two students, with five or more such training units, one chief instructor, and two or more supervisory (check-out) instructors for each platoon-size unit
   b. No special skills, beyond those of the performance being taught—complete instructor guidance provided in the method
   c. Role of instructors—demonstrate performances, observe and critique students' practice evaluate performance. Supervisory instructors administer proficiency tests or ratings. Chief instructor supervises and monitors training program for platoon

(3) Training Content Characteristics
   a. Type of content appropriate—should be suitable for wide variety of procedural jobs

b. Modularized training content, sequenced according to prerequisites, otherwise modules can be studied in any order, subject to equipment availability

(4) Physical Setting Characteristics
   a. Space requirements—none beyond that required by the operational equipment
   b. Designed for use on an as-available basis with operational equipment
   c. Requirements for training devices—probably none, since operational equipment will usually be used
   d. Requirements for printed material—*Training Guide* and record-keeping forms
   e. Dispersed or remote sites—yes, if operational equipment is so located

As these training approaches were examined, it appeared clear that they could be evaluated with respect to the characteristics presented in the preliminary outline. Further, it was felt that the product of such evaluations would be a summation of the significant factors to be considered in making decisions concerning the suitability of these training approaches for use in particular training settings.

AMPLIFICATION OF THE MODEL

At this point attention was shifted to various features known to be involved in military training settings, and the question was asked, "Do these features of training settings make a difference in the feasibility or suitability of various alternative training settings?" If the answer appeared to be "yes," these features of the training settings were incorporated into the outline of characteristics.

Some of the items in the amplified outline of characteristics appeared to relate more to training approaches, and others more to training settings. Since the model was expected to relate to both, and to serve a kind of mediating function between them, the amplified outline of characteristics was then recast explicitly into two parallel, coordinated series of questions. One series of questions was directed at the training approach being considered, and the other series at the training setting involved.

Some thought was given to casting the model in the form of two coordinated checklists by developing comprehensive sets of answers to the questions, so that using the model would involve responding to a series of multiple-choice questions. However, it was felt that, at the present stage of model development, it would be difficult to develop sets of choices comprehensive enough to adequately cover the great variety of possible answers to the questions asked about training approaches and settings. (For example, how many and what kinds of special skills might conceivably be required of students as prerequisites for entering many different courses of study?) Comprehensive tabulation of a long list of possibilities here would be very difficult. Therefore, it was decided, for the present at least, to cast the model in the more general form of open-ended questions, and to rely on the analyst using it to generate, in response to the questions, the specific characteristics or attributes appropriate to a particular training approach and training setting.

The model in its present form of two coordinated series of open-ended questions is not immediately amenable to computerization. After the model as it now stands has been tested for its adequacy and usefulness and revised as necessary, and if it appears that a substantial volume of usage can be expected, it should be possible to modify it for use with a computer.

One possible approach to computerizing the model would be to cast it in the form of two coordinated checklists, as has been discussed. It could be set up to operate in an interactive fashion similar to that planned for the MODIA system for designing instructional programs (Carpenter, 1972). Computer software might be developed for presenting

the questions and sets of answers to the analyst at a computer terminal, recording the answer choices, and summarizing the degree of "fit" between the training approach and the training setting. A substantial effort would be required to develop the software necessary for computerizing the model, and it is felt that its adequacy should be evaluated and estimates of its likely volume of usage obtained before making a decision on whether to computerize the model.

The present version of the model is considered tentative and preliminary. It is described in this interim report in an effort to obtain comments and suggestions from interested Air Force agencies and commands. It is expected that as the model is used to analyze training approaches and training settings and to describe the relationships between them, it will become apparent that additional factors need to be considered. It should be relatively easy to construct additional questions to extend the model to cover these additional factors. In fact, it is planned to suggest that users examine the training approaches and training settings with which they are concerned to see whether additional characteristics of either appear to be important. If so, questions dealing with these characteristics should be added to the model, so that it may more adequately represent the factors important in determining whether these training approaches are feasible and suitable for use in these particular training settings.

THE MODEL

The model is presented on facing pages so that the questions to be asked concerning the training approach may be examined on the left, and the corresponding questions concerning the training setting are readily accessible on the right. Some space is available to the right of the questions so that notes may be made, but it is expected that serious use of the model will require that more extensive answers to the questions be prepared than can be accommodated in this space. Consideration will be given later to a revised format for the model, which would provide adequate space for answers to the questions.

Training Approach

STUDENT CHARACTERISTICS

Notes

A. Implications of training approach for student aptitude levels.

1. Is this training approach especially suitable for students within a particular range of general aptitudes—high, low, or middle—or is it useful for students of all aptitude levels?
2. Is this training approach suitable for students selected for any special aptitudes (mechanical, athletic, verbal, etc.)?

B. Numbers of students.

1. Does this training approach require a minimum number of students to be feasible?
2. Does this training approach deal with students in groups so that there is a relatively fixed increment by which the number of students in training must be increased or decreased?
3. Does this training approach involve a basic instructional group of relatively fixed size (e.g., classroom group, or work or laboratory group)?

C. Special skills or physical characteristics required of students by this training approach.

1. Does this training approach assume that entering students will already have been trained in any special skills?
2. What reading level does this training approach assume that students have?
3. Does this training approach require that students have especially good vision, hearing, or other senses? What about students with poor sensory acuity?
4. Can this training approach accommodate students who are unusually strong (or weak), or large (or small)?

D. Does this training approach have any implications for the sex of students, or for whether students are dealt with in sexually mixed or segregated groups?

STUDENT CHARACTERISTICS

Notes

A. Aptitude level of students in this training setting.

1. Are the students available or assigned to this training setting selected so that their general aptitudes fall within a particular range—high, low, or middle—or are they of all levels of aptitude?
2. Are the students available or assigned to this training setting selected for any special aptitudes (mechanical, athletic, verbal, etc.)?

B. Numbers of students.

1. How many students per week or day are required to be trained in this setting?
3. Do student input rates, or characteristics of the physical facilities in this training setting have implications for the size of increases or decreases in the number of students in training, or the size of the basic instructional group (e.g., classroom group, or work or laboratory group)?

C. Special skills or physical characteristics possessed by students in this training setting.

1. Have students in this setting already been trained in any special skills?
2. What is the reading level of students in this training setting?
3. Have students in this training setting been selected for especially good vision, hearing, or other sensory acuity? Or, do some students have poor sensory acuity?
4. Are students in this training setting unusually strong (or weak), or large (or small)?

D. Are the students in this training setting male or female, or both? If both sexes are represented, does the training setting have any prescriptions or implications as to whether groups of students shall be sexually mixed or segregated?

INSTRUCTOR CHARACTERISTICS

Notes

A. Number of instructors required for this training approach.

1. What are the implications of this training approach for the ratio of instructors to students?
2. Does this training approach require some minimum number of instructors to be feasible?
3. If the number of students is increased substantially, will additional instructors be required? If so, in what ratio to the number of additional students?

B. Special skills or training required for instructors using this training approach.

1. Are instructors required to be expert in the subject matter to be taught?
2. Does this training approach require substantial instructional planning and development effort? Will instructors be expected to be capable in these areas, or will other personnel be expected to carry out these functions?
3. Are the instructors required to possess special skills in managing the instructor-student relationship (classroom management skills, reinforcement techniques, counselling techniques, etc.)?
4. Are the instructors required to have special skills in evaluating student performance?

C. Does this training approach have implications for the roles to be played by instructors—presentation of instruction, evaluation of student performance, management of the instructional system, resources, etc.?

INSTRUCTOR CHARACTERISTICS

Notes

A. Number of instructors available in this training setting.

1. How many instructors are available in this training setting?
2. How many students are to be taught?
3. If the number of students is increased substantially, will additional instructors be available? If so, in what ratio to the number of additional students?

B. Special skills or training possessed by instructors (and possibly other personnel) available in this training setting.

1. Are the instructors expert in the subject matter to be taught?
2. Are the instructors capable of undertaking instructional planning and development activities? If not, and these activities are required, are other persons who possess these skills available?
3. Do the instructors possess special skills in managing the instructor-student relationship (classroom management skills, reinforcement techniques, counselling techniques, etc.)?
4. Do the instructors have special skills in evaluating student performance?

C. Does the training content (or any other aspect of the training setting) have implications for the roles to be played by instructors—presentation of instruction, evaluation of student performance, management of the instructional system, resources, etc.?

CHARACTERISTICS OF TRAINING CONTENT

Notes

A. For what kinds of student performances does this training approach appear to be suitable? The following list can be considered when deciding what kinds of student performance may be trained with this approach (comments should also be made concerning any additional kinds of student performance for which this training approach appears to be suitable):

- Recall and application of facts
- Serial procedures
  - Fixed
  - Variable or branching
- Tracking and aiming
- Searching and scanning
- Discrete or continuous performance
- Noise-filtering: detecting cues or symptoms among a background of extraneous stimulation
- Skilled actions: activities that the untrained person cannot perform satisfactorily, even if he is told what to do
- Discrimination behavior: recognizing differences between stimuli so that different responses can be made to them
- Complex perceptual-motor behavior
- *Problem-solving: recall and application of concepts and principles*

B. Implications (or requirements) of training approach for organization of training content

1. What basis does this training approach provide (or specify) for the modularizing of training content?
2. Does the training approach have any implications for the sequencing of training content?

C. What kinds of instructional activities are implied by the training approach? The following list gives several examples of kinds of instructional activities (others should be added if they are needed):

- Presentation of knowledge
- Practice of knowledge
- Practice of performance
- *Demonstration*
- Provision of feedback, or knowledge of results, to students.
-
-

CHARACTERISTICS OF TRAINING CONTENT

Notes

A. What kinds of student performances are required by the training objectives? The following list may be useful in describing these kinds of performances (any additional types or terms needed to describe the kinds of performances specified by the training objectives should be used also):

- Recall and application of facts
- Serial procedures
  - Fixed
  - Variable or branching
- Tracking and aiming
- Searching and scanning
- Discrete or continuous performance
- Noise-filtering: detecting cues or symptoms among a background of extraneous stimulation
- Skilled actions: activities that the untrained person cannot perform satisfactorily, even if he is told what to do
- Discrimination behavior: recognizing differences between stimuli so that different responses can be made to them
- Complex perceptual-motor behavior
- Problem-solving: recall and application of concepts and principles

B. Factors in the training setting that influence the organization of training content

1. Are there, within the training content itself, natural divisions and prerequisite relationships that should be considered in modularizing and sequencing training content?
2. Are there other factors in the training setting (e.g., availability or arrangement of physical facilities, command policies, etc.) that have any implications for the modularizing and sequencing of training content?

C. What kinds of instructional activities are implied by the training content (and possibly by other aspects of the training setting)? The following list gives several examples of kinds of instructional activities (others should be added if they are needed):

- Presentation of knowledge
- Practice of knowledge
- Practice of performance
- Demonstration
- Provision of feedback, or knowledge of results, to students.
-
-
-

Notes

D. What effect does this training approach have on the effort necessary to make changes in the training content? What kinds of units or modules of content are involved in this training approach? What formats or media?

MATERIEL AND FACILITIES REQUIREMENTS

A. What are the implications of this training approach, considered in conjunction with specified kinds of training content, for the space required to conduct training? What kinds of space are needed (classroom, laboratory, or practical exercise facilities, outdoor ranges or maneuver areas, etc.)? How much space is needed (at least in relative terms)? What elements in the training approach or method are related to space needs (e.g., one classroom for each class of 30 students, one terminal for each student using the system, or one learning station for each module of content)?

B. What implications can be drawn from a consideration of this training approach, in conjunction with specified kinds of training content, concerning the equipment and materiel required to conduct training? The following list suggests the kinds of equipment and materiel that may be required (additional types of equipment and materiel should be listed if needed):

- Operational equipment
- Obsolete or nonoperational equipment
- Audiovisual equipment
- Part-task training devices
- Low-fidelity simulators
- Large, high-fidelity simulators
- Printed training materiels
-
-

C. What are the implications of this training approach for the various kinds of situations in which training might be conducted? Examples are shown in the following list (additional kinds of locations should be considered if appropriate):

- Formal school training
- On-the-job training
- Dispersed locations
- Remote sites
-
-

D. What are the frequency and extent of training content changes that may be expected in this training setting?

Notes

MATERIEL AND FACILITIES AVAILABLE

A. What kinds and amounts of space for conducting training are available or can be obtained in this training setting?

B. What kinds and amounts of equipment and materiel for conducting training are available or can be obtained in this training setting? The following list suggests the kinds of equipment and materiel that may be available (additional types of equipment and materiel should be listed if needed):

- Operational equipment
- Obsolete or nonoperational equipment
- *Audiovisual equipment*
- Part-task training devices
- Low-fidelity simulators
- Large, high-fidelity simulators
- Printed training materiels
-
-

C. What kinds of training situations does this training setting involve? Examples are shown in the following list (additions to this list should be made if needed):

- Formal school training
- On-the-job training
- Dispersed locations
- Remote sites
-
-

ADMINISTRATIVE CONSIDERATIONS

Notes

A. Implications of training approach for student flow.

1. Does this training approach have any implications as tc whether the course of instruction shall be of fixed or variable length for different students?
2. Does this training approach have implications for the availability of information from which to predict students' dates of availability for assignment (graduation), if a variable length course of instruction is used?

B. What are the implications of this training approach for individualization of instruction? The following list presents examples of kinds of individualization of instruction:

- Diagnostic proficiency individualization: Students are tested to determine whether they need to study sections of the training content and may skip much or all of the training if they can show they have already mastered the content.
- Remedial individualization: Students can study extra training material designed to help them make up for deficiencies in their preparation.
- Enrichment individualization: Students can study extra training material designed to teach information and skills beyond those required for graduation from the course.
- Rate individualization: Students may proceed at their own pace through the required training materials.
- Alternative methods of media individualization: Students have a choice (at least part of the time) as to the method or medium by which they study the training content.

C. Does this training approach indicate that a fixed, standard level of skill or proficiency is expected of graduates of the instruction, or that each student is expected to develop his capabilities as far as he can, and in areas that least partly determined by his own interests?

ADMINISTRATIVE CONSIDERATIONS

Notes

A. Requirements of training setting regarding student flow.

1. Does the training setting require a fixed length for the course of instruction, or is a course of instruction of variable lengths for different students permitted?
2. What requirements for advance information on students' dates of availability for assignment (graduation), does this training setting impose, if a variable length course of instruction is used?

B. What are the policies in this training setting regarding individualization of instruction? Are resources such as diagnostic tests, remedial or enrichment training materials, or alternative sets of training materials using different methods or media available to permit individualization of instruction? The following list presents examples of kinds of individualization of instruction:

- Diagnostic proficiency individualization: Students are tested to determine whether they need to study sections of the training content and may skip much or all of the training if they can show they have already mastered the content.
- Remedial individualization: Students can study extra training material designed to help them make up for deficiencies in their preparation.
- Enrichment individualization: Students can study extra training material designed to teach information and skills beyond those required for graduation from the course.
- Rate individualization: Students may proceed at their own pace through the required training materials.
- Alternative methods or media individualization: Students have a choice (at least part of the time) as to the method or medium by which they study the training content.

C. Do the policies in this training setting indicate that a fixed, standard level of skill or proficiency is expected of graduates of the instruction, or that each student is expected to develop his capabilities as far as he can, and in areas at least partly determined by his own interests?

D. **Does this training approach make provision for, or have any implications for, the provision of management information? The following list indicates some of the kinds of management information that might be involved:**

Notes

- Information on students' progress through the course of training
- Information on the adequacy of various parts of the course of training
- Information on the adequacy of graduates' performance
- Information on instructional resource utilization
-
-

COST FACTORS

A. **What kinds of capital expenditures will be necessary if this training approach is implemented? Examples of capital expenditures—new or remodeled facilities, or equipment purchases.**

B. **What kinds and amounts of operating expenses will be involved if this training approach is implemented? Areas in which operating expenses may be important include personnel, physical facilities, and instructional materials.**

C. **What are the implications of this training approach for training development costs? Included in these costs should be both initial training analysis and development costs (job analysis, training content analysis, development of instructional system, and materials) and the costs involved in repeating these analysis and development steps when necessitated by training content changes.**

D. **Does this training approach involve any other costs, not accounted for above?**

Notes

D. **Does this training setting require that various kinds of management information be generated, summarized, and reported? The following list indicates some of the kinds of management information that might be required:**

- Information on students' progress through the course of training
- Information on the adequacy of various parts of the course of training
- Information on the adequacy of graduates' performance
- Information on instructional resource utilization
-
-

COST FACTORS

A. **Are the resources available in this training setting to support the capital expenditures necessary to implement this training approach?**

B. **Are the resources available in this training setting to support the operating expenses that this training approach would involve?**

C. **Does the training setting provide for necessary training development costs, both when training is initially set up, and when changes in training content make it necessary to partially repeat the training development steps?**

D. **Can the training setting provide for any miscellaneous costs, not discussed above?**

Chapter 3

DISCUSSION OF THE MODEL

During the development of the model, a number of difficulties and tempting diversions were encountered. These are discussed in the following section. Also, in a later section of this chapter, the relationships of this model to several major systems and projects involving Air Force technical training are discussed.

COMMENTS ON THE MODEL

Trying to capture as many as possible of the significant factors in the training universe within the two categories, training approaches and training settings, has been difficult. A sustained effort was made, in developing the model, to keep its purpose in a dominant, governing position. In shaping the questions for the model so that they tap significant factors in the training situation, there has been a strong tendency for some elements in the training setting—particularly training content—to assume the status of additional, independent categories. In fact, a description of the training universe merely for the sake of description might have led to several major elements having coordinate status—training approaches, students, instructors, training content, physical facilities of the training establishment, and so forth. However, because the purpose of the model is to evaluate the potential suitability and usefulness of training approaches in particular training settings, the model has been cast in the form of these two categories.

In the course of developing the model, there has also been a tendency to think of the training approach as generating requirements in the training situation, and to feel that the training setting can show whether, or to what extent, these requirements may be satisfied. It was found, however, that this conceptualization of requirements vs. resources with which to satisfy them was not particularly useful or valid, because requirements also arose out of elements in the training setting, particularly the training content and the policies of the training agency or command. This way of looking at the problem was set aside in favor of the training approach/training setting conceptualization.

In developing the part of the model dealing with instructor characteristics, account was taken of the work of Melching and Whitmore (1973) on the requirements for effective performance by Army instructors in classroom teaching. Their model of the functions of a master instructor covers a limited area of performance, and as such, is much more detailed in the area of instructor performance than the model described in this report. However, the instructor characteristics part of this model is designed to be consistent with the Melching and Whitmore model.

The classification of the kinds of performances required of students by the training objectives, under "Characteristics of Training Content" in the model, has been a difficult area to deal with. Clearly, the kinds of performances expected of students after training should determine the kinds of activities in which they engage during training. The nature of these learning activities is important in determining whether training approaches (i.e., any methods, techniques, devices, or systems being considered for use in training) are appropriate and effective. It also has important implications for many other elements of

the training setting, such as the amount and kind of space required, the skills required of instructors, and the aptitudes and previous training required of students.

However, in the MODIA system (Bretz, 1972, p. 5), any classification of the training content is strictly avoided. Individuals responding to the MODIA curriculum analysis questionnaire must infer the nature of the training content with which they are dealing and make decisions about whether the training will be in a classroom, whether special equipment is needed, whether individual or interactive skills are involved, whether this learning event requires visual means (besides print), sound, or motion, and so forth. In general, the nature of the activities occurring in a "learning event" is not explicitly considered in MODIA, and the instructional designer who responds to the curriculum analysis questionnaire is required to examine these activities and make inferences from them with no guidance from any conceptualization of the kinds of student performances being dealt with.

In the model described in this report, an attempt was made to provide analysts with a frame of reference for the performances required of students, to aid them in inferring from these performances the appropriateness or probable effectiveness of various training approaches. In developing the classification of the kinds of performance required of students, several previous efforts at classifying human performance were studied, primarily those in Bloom (1956), Gagne (1970), and Fleishman and Stephenson (1970).[1] The systematic approach to training of R.G. Smith (1971) was also consulted.

It was concluded that comprehensive classifications of human performance have been difficult to develop and are of limited usefulness. In developing the classification of the kinds of performances required of students for this model, considerable use was made of Gagne's (1970) eight types of learning and of Bloom's *Taxonomy of Educational Objectives* (1956). However, the attempt was made to describe the kinds of performances listed in the classification in terms that were more relevant to Air Force technical training content than the descriptions of performances offered by Gagne and Bloom. The classification of kinds of performances required of students is repeated below, with examples given for each kind of performance listed.

1. Recall and application of facts
    - Remembering the terminology of an equipment system and the names and locations of the controls so that the student can speak or write with reasonable fluency concerning the system
    - Making specific control settings
2. Serial procedures
    a. Fixed
        - Energizing electronic equipment
        - Crew drill in a weapons system
    b. Variable, or branching
        - Troubleshooting complex equipment using proceduralized methods and job aids
        - Emergency procedures, which often involve branching away from otherwise fixed procedures
3. Tracking and aiming
    - Radar tracking
    - Aiming a gun
4. Searching and scanning
    - Aircraft detection
    - Aerial observation

[1] This project extended over several years and resulted in numerous technical reports. The specific report cited was chosen because it gives a good overview of the project and lists the project reports.

- Scanning—quick search, subordinate to some other task, such as scanning instrument panel while driving

5. Discrete or continuous performance
   a. Discrete—step-by-step performance, with individual steps being clearly separate elements of the performance
   b. Continuous—cannot be divided into clearly separate elements; continuing performance, usually guided and modulated by feedback
6. Noise-filtering—detecting cues or symptoms among a background of extraneous stimulation
   - Listening to an engine to diagnose malfunctions
   - Detection of targets on radar scope
7. Skilled actions—activities that the untrained person cannot perform satisfactorily, even if he is told what to do
   - Clutching and shifting an automobile with a manual transmission
   - Precision measurement with a micrometer
8. Discrimination behavior—recognizing differences between stimuli so that different responses can be made to them
   - Aircraft, tank, or automobile identification
   - Identifying different wave forms on an oscilloscope
9. Complex perceptual-motor behavior
   - Driving a car
   - Flying an airplane
10. Problem-solving—recall and application of concepts and principles
    - Troubleshooting complex equipment without proceduralized methods and job aids
    - Planning the work of a group of people and assigning tasks

This classification of the kinds of performances required of students has a good deal in common with the types of learning discussed in AFM 50-2 (U.S. Air Force, 1970, pp. 5-12, 5-13), and in AFP 50-58 (U.S. Air Force, 1973, Chapter 3), which were undoubtedly derived from much the same sources. It is not considered crucial whether the classification described above, or one of those described in AFM 50-2 or AFP 50-58, is used in this model. It is considered important that the instructional designer be given some guidance in deriving the implications of type of training content for training approaches.

RELATIONSHIP OF MODEL TO ISD, AIS, AND MODIA

A number of major programs are in various stages of implementation in the U.S. Air Force technical training environment. Most important of these are the Instructional System Development (ISD) effort (U.S. Air Force, 1970, 1973), the Advanced Instructional System (AIS) effort (Rockway and Yasutake, 1973), and the MODIA system (Carpenter, 1972; Carpenter and Horner, 1972; Bretz, 1972; and Petruschell and Carpenter, 1972). This section will discuss the relationship of the model presented in this report to these major programs or systems. Generally, it is expected that this model should be useful within the frameworks of all of these programs or systems.

The ISD effort is a large, Air Force-wide program in which the major training innovations of the 1950s and 1960s are being implemented. The model for matching training approaches with training settings should be useful primarily in connection with the activities of Step 4 of the ISD process—Plan, Develop, and Validate Instruction. It is not expected that the model would be used formally for every decision made in the course of Step 4 activities in the ISD process, although many of the factors in the model

might be informally weighed in making these decisions. However, whenever any substantial decisions concerning instructional methods, techniques, media, or devices are to be made, the model should be useful. It would probably be useful also in making decisions concerning testing methods and devices in Step 3 of the ISD process.

It should be emphasized that the model is designed for a much broader scope of usefulness than the relatively narrow area of instructional media selection. The application of the model during development to some basic instructional system techniques, such as peer instruction and mastery testing, for example, and to sophisticated instructional devices such as the Lincoln Training System, should demonstrate the wide applicability of the model.

The AIS is a computer-based system for the administration and management of individualized technical training on a large scale, presently being developed at Lowry Air Force Base. The system is to encompass the whole range of instructional activities from the development of instructional materials and strategies to the administration and evaluation of instruction involving a variety of media and methods. After the development and demonstration of the system on three courses at Lowry Air Force Base, it is likely that it will be expanded and installed at other locations so that a substantial part, perhaps most, of Air Force technical training may be carried out within such systems some years hence.

In terms of the definitions set out early in this report, the AIS, along with a given body of training content, may be considered a training setting. Because of its probable importance in Air Force technical training in the near future, it is likely to be the single most important training setting to which the model described in this report might be applied.

Within the general framework of the AIS, as it is used for additional courses and at additional locations, there will be a large number of decisions to be made concerning what this report has called instructional approaches; strategies and methods of instruction, instructional devices, job aids, and so on. The general model developed in this project could be adpated for use in the AIS by describing the main characteristics of the AIS as a training setting. Then the characteristics of a particular training content could be added, and one would have a very substantial set of requirements and standards, against which to evaluate any training approach which one might wish to consider. Thus the model described in this report is seen as quite capable of being incorporated into the AIS as an aid in its expansion and installation at other locations.

The MODIA system has been developed for the U.S. Air Force by the Rand Corporation (in a project entitled "Analysis of Systems for Air Force Education and Training"). MODIA (A Method of Designing Instructional Alternatives) is a comprehensive methodology for designing instructional programs.

The greatest strength of the MODIA system is its capabilities for spelling out in detail the consequences and costs of a given set of decisions concerning an instructional program. Also, in its computerized form, it will make possible the ready comparison of the consequences and costs of alternative decisions concerning an instructional program.

However, the MODIA system is relatively weak in the guidance it offers to instructional planners to help them make the major, early decisions in designing an instructional program. The MODIA techniques for bringing to bear on the instructional design process the policies and constraints of the training command or agency and the implications of the particular training content involved depend on highly detailed, branching questionnaires. The detailed choices posed in these questionnaires are inevitably highly structured and tend to limit the conceptualization of the instructional process. In addition, they are often highly abstract. In short, it is argued that in the area of major decisions concerning training approaches which must be made early in the instructional design process, the MODIA system is limited in its scope and flexibility, and in the guidance it offers to

instructional planners. In an earlier part of th Chapter, this point has already been made in more detail in the discussion of the implications of the kinds of performances required of students (i.e., training content) for decisions regarding training approaches.

The model described in this report, by virtue of its flexible, open-ended nature, and the fact that it concentrates entirely on the implications of all aspects of the training setting for these major, early decisions regarding training approaches, should handle this part of the instructional design process more adequately than the MODIA system does. Once these major, early decisions regarding training approaches have been made, the MODIA system for spelling out in detail their consequences and costs should be quite useful.

Chapter 4

APPLICATION AND TESTS OF THE MODEL

This chapter presents the trial application of the model to one training approach, the Lincoln Training System (LTS-4), and briefly describes plans for testing and revising the model, to be carried out during the remainder of the project.

APPLICATION OF THE MODEL TO THE LTS

The LTS is briefly described in Chapter 2, and is more completely described in Frick (1973). In this trial application it was found that some information was not available, for example, the cost of an LTS terminal. In some cases, the questions posed by the model have had to be answered rather generally, since the LTS was not being examined in relation to a particular training setting. The specific training content for which the use of the LTS is being considered would be the most important aspect of the training setting; if this were known, much more specific and detailed answers to many of the questions posed by the model would be possible.

In the following section, the answers to the Training Approach questions in the model appear in italics.

Training Approach

STUDENT CHARACTERISTICS

A. Implications of training approach for student aptitude levels.

1. Is this training approach especially suitable for students within a particular range of general aptitudes—high, low, or middle—or is it useful for students of all aptitude levels?

   1. Not applicable; depends upon the nature of the instructional material developed for use in the system.

2. Is this training approach suitable for students selected for any special aptitudes (mechanical, athletic, verbal, etc.)?

   2. Audio capability should make LTS particularly suitable for students with low reading ability.

B. Numbers of students.

1. Does this training approach require a minimum number of students to be feasible?

   1. No minimum number of students; can be used with a single student.

2. Does this training approach deal with students in groups so that there is a relatively fixed increment by which the number of students in training must be increased or decreased?

   2. Deals with students individually; no fixed increment by which the number of students must be increased or decreased.

3. Does this training approach involve a basic instructional group of relatively fixed size (e.g., classroom group, or work or laboratory group)?

   3. No basic instructional unit of fixed size; individual instruction.

C. Special skills or physical characteristics required of students by this training approach.

1. Does this training approach assume that entering students will already have been trained in any special skills?

   1. Entering students need only simple instructions in how to operate keyboard.

2. What reading level does this training approach assume that students have?

   2. No assumptions about reading level; with suitable instructional material, audio capability makes it possible to teach students who can't read at all.

3. Does this training approach require that students have especially good vision, hearing, or other senses? What about students with poor sensory acuity?

   3. System should be useful for students with considerably below normal visual and/or auditory acuity, but not particularly suitable for blind or deaf students.

4. Can this training approach accommodate students who are unusually strong (or weak), or large (or small)?

   4. No implications for physical strength or size of students.

D. Does this training approach have any implications for the sex of students, or for whether students are dealt with in sexually mixed or segregated groups?

LTS has no implications for sex of students, or for whether students are dealt with in sexually mixed or segregated groups.

INSTRUCTOR CHARACTERISTICS

A. Number of instructors required for this training approach.

1. What are the implications of this training approach for the ratio of instructors to students?

   1. With suitable instructional materials, no instructors are required, except possibly for general supervision and check-out of materials.

2. Does this training approach require some minimum number of instructors to be feasible?

   2. No minimum number of instructors is required.

3. If the number of students is increased substantially, will additional instructors be required? If so, in what ratio to the number of additional students?

   3. No additional instructors are needed, if the number of students is increased substantially.

B. Special skills or training required for instructors using this training approach.

1. Are instructors required to be expert in the subject matter to be taught?

   1. With suitable instructional material, instructors do not need to have subject matter expertise.

2. Does this training approach require substantial instructional planning and development effort? Will instructors be expected to be capable in these areas, or will other personnel be expected to carry out these functions?

   2. *Instructional material must be developed for the LTS. Preparation of instructional material for procedural tasks of low or moderate complexity is not unduly expensive, according to Frick and Karp (1973); development of instructional material for other kinds of training content may be more difficult and expensive.*

3. Are the instructors required to possess special skills in managing the instructor-student relationship (classroom management skills, reinforcement techniques, counselling techniques, etc.)?

   3. *The LTS does not require that instructors have special skills in managing the instructor-student relationship.*

4. Are the instructors required to have special skills in evaluating student performance?

   4. *The LTS does not require that instructors have special skills in evaluating student performance. If instructional materials are developed suitably, the LTS can monitor and evaluate student performance automatically.*

C. Does this training approach have implications for the roles to be played by instructors—presentation of instruction, evaluation of student performance, management of the instructional system, resources, etc.?

Instructors will have little more to do than make the equipment available to students and hand out instructional materials, while the training is going on. Instructors (or other personnel) will have a good deal of work to do, at least initially, in developing instructional materials.

CHARACTERISTICS OF TRAINING CONTENT

A. For what kinds of student performances does this training approach appear to be suitable? The following list can be considered when deciding what kinds of student performance may be trained with this approach (comments should also be made concerning any additional kinds of student performance for which this training approach appears to be suitable):

- Recall and application of facts
- Serial procedures
  - Fixed
  - Variable or branching

- Tracking and aiming
- Searching and scanning
- Discrete or continuous performance
- Noise-filtering: detecting cues or symptoms among a background of extraneous stimulation
- Skilled actions: activities that the untrained person cannot perform satisfactorily, even if he is told what to do
- Discrimination behavior: recognizing differences between stimuli so that different responses can be made to them
- Complex perceptual-motor behavior
- Problem-solving: recall and application of concepts and principles

The LTS appears to be suitable, assuming that adequate instructional material has been prepared, for the following kinds of learning activities by students:

- *Recall and application of facts*
- *Serial procedures, both fixed and variable*
- *Discrete performances*
- *Discrimination behavior (assuming that the stimuli are visual or auditory, and the fidelity of reproduction of the LTS is adequate)*
- *Problem-solving*

With ingenious development of instructional material, the LTS should be useful for a wide range of types of student performance and its capabilities should be carefully assessed in relation to the specific training content involved in a particular training setting.

B. Implications (or requirements) of training approach for organization of training content

1. What basis does this training approach provide (or specify) for the modularizing of training content?

   1. *The 12 visual images available on one fiche, and the 750-fiche storage capability of the LTS provide opportunities (and limitations) for the modularization of training content.*

2. Does the training approach have any implications for the sequencing of training content?

   2. *The LTS has no implications for the sequencing of training content, except that its random access feature provides great flexibility in sequencing.*

C. What kinds of instructional activities are implied by the training approach? The following list gives several examples of kinds of instructional activities (others should be added if they are needed):

- Presentation of knowledge
- Practice of knowledge
- Practice of performance
- Demonstration
- Provision of feedback, or knowledge of results, to students.
-
-

The LTS is clearly suitable for presentation of knowledge and practice of knowledge, assuming that adequate instructional material has been prepared. It can provide guidance, both graphic and spoken, for the practice of performance. Feedback to students can be incorporated into the instructional material.

D. What effect does this training approach have on the effort necessary to make changes in the training content? What kinds of units or modules of content are involved in this training approach? What formats or media?

Some kinds of instructional material for the LTS can be readily modified—specifically, the kind that consists of pictures of an expert performing a task, with verbal commentary. Other kinds of instructional material may not be so easy to modify, especially those that require considerable analysis before deciding on the specific material to present. In any case, microfiche can be produced relatively cheaply in small quantities—an advantage over conventional printed materials.

MATERIEL AND FACILITIES REQUIREMENTS

A. What are the implications of this training approach, considered in conjunction with specified kinds of training content, for the space required to conduct training? What kinds of space are needed (classroom, laboratory, or practical exercise facilities, outdoor ranges or maneuver areas, etc.)? How much space is needed (at least in relative terms)? What elements in the training approach or method are related to space needs (e.g., one classroom for each class of 30 students, one terminal for each student using the system, or one learning station for each module of content)?

Indoor space is needed for the LTS; the amount depends on the number of units needed. One LTS is needed for each student, while the student is using it. In one experimental try-out of the LTS, students spent between one-half and two-thirds of their total class time on the system, so at the

most two terminals would be needed for every three students, in a one-shift operation.

B. What implications can be drawn from a consideration of this training approach, in conjunction with specified kinds of training content, concerning the equipment and materiel required to conduct training? The following list suggests the kinds of equipment and materiel that may be required (additional types of equipment and materiel should be listed if needed):

- Operational equipment
- Obsolete or nonoperational equipment
- Audiovisual equipment
- Part-task training devices
- Low-fidelity simulators
- Large, high-fidelity simulators
- Printed training materiels
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No equipment, besides the terminals themselves and the instructional materiel to use in them, should be necessary to use the LTS. Relevant elements of operational equipment can be presented, visually and auditorily, on the LTS; the LTS is an audiovisual system, and with suitable instructional materiels it can function as a part-task training device or job aid, and as a low fidelity simulator for many purposes.

C. What are the implications of this training approach for the various kinds of situations in which training might be conducted? Examples are shown in the following list (additional kinds of locations should be considered if appropriate):

- Formal school training
- On-the-job training
- Dispersed locations
- Remote sites
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Since the LTS is a stand-alone facility, it can be used in almost any training situation in which indoor space can be provided.

ADMINISTRATIVE CONSIDERATIONS

A. Implications of training approach for student flow.

1. Does this training approach have any implications as to whether the course of instruction shall be of fixed or variable length for different students?

   1. *Training utilizing the LTS may be either of fixed or variable length. Since the training is individualized, widely variable lengths of instruction for different students are quite feasible, depending on the instructional material and the administrative system involved.*

2. Does this training approach have implications for the availability of information from which to predict students' dates of availability for assignment (graduation), if a variable length course of instruction is used?

   2. *Detailed information on student performance should be available from the LTS as a partial basis for predicting students' dates of availability for assignment (graduation).*

B. What are the implications of this training approach for individualization of instruction? The following list presents examples of kinds of individualization of instruction:

- Diagnostic proficiency individualization: Students are tested to determine whether they need to study sections of the training content and may skip much or all of the training if they can show they have already mastered the content.
- Remedial individualization: Students can study extra training material designed to help them make up for deficiencies in their preparation.
- Enrichment individualization: Students can study extra training material designed to teach information and skills beyond those required for graduation from the course.
- Rate individualization: Students may proceed at their own pace through the required training materials.
- Alternative methods of media individualization: Students have a choice (at least part of the time) as to the method or medium by which they study the training content.

All kinds of individualization of instruction should be available on the LTS, if suitable instructional material is prepared.

C. Does this training approach indicate that a fixed, standard level of skill or proficiency is expected of graduates of the instruction, or that each student is expected to develop his capabilities as far as he can, and in areas at least partly determined by his own interests?

Use of the LTS has no implications for the question of whether students are all expected to develop a fixed, standard level of skill or proficiency, or to develop their capabilities as far as they can and in the areas at least partly determined by their own interests; if suitable instructional materials are available, either may be done.

D. Does this training approach make provision for, or have any implications for, the provision of management information? The following list indicates some of the kinds of management information that might be involved:

- Information on students' progress through the course of training
- Information on the adequacy of various parts of the course of training
- Information on the adequacy of graduates' performance
- Information on instructional resource utilization
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The LTS should make readily available management information such as that on students' progress through the course of training. It should be possible to derive, by analysis of the detailed records of student performance during learning which are available from the LTS, information on the adequacy of various parts of the course of training. From records of student use of the LTS terminals, information on the utilization of this particular instructional resource would be available.

COST FACTORS

A. What kinds of capital expenditures will be necessary if this training approach is implemented? Examples of capital expenditures—new or remodeled facilities, or equipment purchases.

Capital expenditures necessary in implementing the LTS will be mainly the cost of the LTS equipment itself.

B. What kinds and amounts of operating expenses will be involved if this training approach is implemented? Areas in which operating expenses may be important include personnel, physical facilities, and instructional materials.

If the LTS is used, operating expenses are likely to be less than with conventional instruction, because of reduced needs for instructors, both in numbers and in skill levels. Instructional materials may or may not be cheaper than conventional printed materials, depending on volume of production and relative durability of microfiche as compared with printed materials. Space required to store instructional materials may well be less, since microfiche are miniaturized.

C. What are the implications of this training approach for training development costs? Included in these costs should be both initial training analysis and development costs (job analysis, training content analysis, development of instructional system, and materials) and the costs involved in repeating these analysis and development steps when necessitated by training content changes.

Initial training development costs, to provide suitable instructional material for the LTS, are likely to be substantial. Simple applications may be relatively economical (Frick and Karp, 1973), but more imaginative and complicated applications will be somewhat expensive. The cost of revising instructional materials when the training content changes is likely to be less than for conventional instruction, especially when relatively small volumes are involved. Thus, it is important to consider the numbers of students who are likely to use the instructional materials. If the substantial initial training development costs can be distributed over large numbers of students, the relatively low operating costs may make the LTS an attractive alternative.

D. Does this training approach involve any other costs, not accounted for above?

At this point, additional costs that use of the LTS might involve cannot be foreseen.

"If suitable instructional material is available" is a refrain running through many of the answers to questions about the LTS. The inference is clear that, in considering whether to adopt the LTS, it will be very important to examine the training setting carefully to see whether the resources and skills needed to develop suitable instructional materials will be available.

PLANS FOR TESTING AND REVISING THE MODEL

During the remainder of the project is is planned to confront the model with the reality it is designed to deal with: the real-life working situation of an instructional planner in an Air Force Technical Training Center. Information of three different kinds will be gathered in an effort to test the model. First, reactions to the model will be sought from persons in Air Force Technical Training Centers who are in positions in which they should be able to use the model in their work. Second, information on training settings will be gathered, so that side of the model may be applied to learn whether it appears to be workable and useful. Third, it is planned to have one or more research personnel at HumRRO attempt to use the model, to see whether it can be used by anyone besides its designer (the project principal investigator).

Information Gathering from Potential Users of the Model

It is planned to interview training managers and commanders, instructional planners and developers, and instructors at Air Force Technical Training Centers at Chanute, Keesler, Sheppard, and Lowry AFBs and at the Military Training Center at Lackland AFB. After these persons have been acquainted with the objective of the project and the intended use of the model, they will be asked to react to the model. Are the questions reasonably answerable? Are any of the questions inappropriate or irrelevant? What additional questions should be asked? Information will also be gathered on how decisions are currently made concerning training approaches, methods, techniques, equipment, and so forth, and what factors are weighed in making these decisions. Information on the training development processes, as they now operate, will be sought, mainly from ISD personnel.

Information on Training Settings

During the planned visits to Technical Training Centers and the Military Training Center, information will be sought on the courses taught, the facilities and resources available, and other aspects of the training settings. It is hoped that at least one training setting, including student characteristics and training content, can be selected for more intensive analysis, so that the usefulness of the training setting side of the model can be assessed.

Generalized User Try-Out of the Model

At HumRRO, work is already underway in which a research assistant is applying the model to a number of training approaches, to determine whether persons not intimately involved in developing the model can use it. When information on training settings has been gathered, research assistants will be asked to apply the training setting side of the model to help assess its usability.

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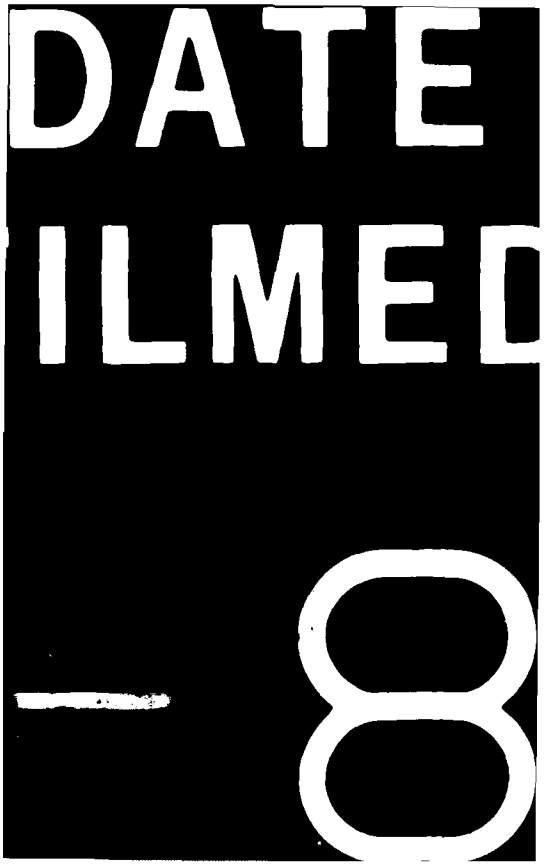
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